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Comparative Studies of Half Breed or "Mestizo" and Native Chickens

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Thesis presented for graduation from the College of Agriculture, No. 51.

Relatively speaking, poultry farming is a very profitable business, or can be made so in this country, since the natural advantages here are exceptionally good for such an industry. The little interest in poultry raising which most Filipino farmers seem to have at the present time is undoubtedly due to the failures commonly experienced. The causes of such failures are easy to see. They are the "lax methods of management, infestation of lice, continued use of land year after year with little attention to sanitation, mongrel stock, poor selection, no system of feeding," and lack of experience. Extensive and costly investigation and experimentation in other countries have enabled many poultry breeders and raisers to remove the seemingly unsurmountable obstacles, so the possibilities of this industry for them no longer remain doubtful. It behooves those who are interested in poultry in this country to do the same thing in order to place the industry on its proper basis.

This country offers varied natural advantages for poultry farming. The climatic conditions are very favorable, and in many places simply ideal. There are many situations in rolling country to be found everywhere that are naturally well drained, and thus suited to poultry. There are also level places where the rainfall is not excessive and is quite evenly distributed throughout the year and thus well suited for poultry. A good supply of water from rivers and creeks is usually accessible in such places.

The long dry season, while making the atmospheric conditions very favorable, yet does not kill or prevent the growth of many plants. Feed can therefore be grown at all times during the year. The two most common crops,

corn and rice, which can be grown during the year, form the most important part of the ration for poultry. Other feeds which can also be grown in more than one crop a year are cowpeas, mongo, *cajanus* or pigeon pea, cassava, sweet potatoes, and the newly introduced varieties of sorghum, including kaffir corn, millet, etc., which have proven to be successful during both the dry and the rainy seasons observed at the College; and vegetable crops like mustard, lettuce, etc., can be produced at any time. Green feeds are abundant. Besides the several varieties of ordinary grasses which are common in yards and in most other places, there are also guinea grass and teosinte which have been found to be a suitable green feed for chickens. For meat food a very practical and cheap feed are termites, commonly called *anay*,* which are more or less destructive to wood; the College is using them freely to feed chicken in all stages of growth. This can be found in most farms and the use made of it for feed accomplishes a double purpose. Other forms of animal food, such as beef scrap and ground bone, can be purchased easily from the markets, especially near large towns or cities. Poultry house appliances can be made very cheaply and satisfactorily out of purely Philippine materials, and for this purpose bamboo and nipa are the best.

There is always a ready market in this country for poultry products. In nearly all the towns in the provinces chickens and eggs can always be sold, while in large cities they command very high prices. Moreover, any prospective poultry raisers in the Islands need do no more than inspect the figures of the Philippine Bureau of Customs, as given below in tabulated form, in regard to the importation of poultry products into this country, to realize the necessity of raising more chickens for meat and eggs, in order to meet the demands of the home market. It goes without saying that, with all the advantages mentioned above, poultry farming can be combined with other forms of farming, and will prove very profitable. It is true that on most farms chickens are reared, but there is ample room for improvement in the directions mentioned, namely: quality of stock, housing, feeding, and selection. If improvement of this sort is effected there is no doubt that we will be able within a comparatively short time to supply the demand for home consumption, which is our most pressing need at the present time.

* The species of termites commonly used for feeding chickens, both young and adult, in the College of Agriculture is *Microcerotermes los-banosensis* Oshima. This is preferable to the other species in that its soldiers do not have very powerful mandibles and, therefore, are comparatively harmless to the young fowls. *M. los-banosensis* is of very common local occurrence.

IMPORTATION OF POULTRY PRODUCTS (2)

Product	*1911*		*1912*		*1913*	
	Quantity	*Value*	*Quantity*	*Value*	*Quantity*	*Value*
Meat product and game.....	——	₱14,076	——	₱14,890	——	₱23,272
Eggs in natural form.....	4,139,467	623,741	4,628,658	727,072	4,471,808	716,624
TOTAL.....	4,139,467	₱637,817	4,628,658	₱741,962	4,471,808	₱739,896

Experiments have shown that the native chickens in their present condition are a very inferior breed. They are no better than the common unimproved chickens of other countries and are generally hopelessly mongrel throughout the Archipelago. In his paper (3) on the Philippine chicken, Allarey says that the native chickens have no well established and well defined type, and represent neither a meat nor an egg producing breed. He believes that they average less than half the weight of the meat breeds of other countries, and have no chance of development into a meat breed. The average number of eggs laid per year by the average native hens is supposed to be about 50, which is indeed very low, as compared to that of pure-bred fowls.

In order to put the poultry business in this country on a better basis, it is believed to be necessary to give the native hens better treatment as regards food, shelter, and care; to practice intelligent selection of all breeding stock; to cross the native hens with imported pure-bred roosters; or to raise standard pure breeds imported from other countries. Since there is a great doubt as to the adaptability of imported pure-bred chickens in this country, on account of the change of conditions to which they may be subjected, and since inferiority of native hens in egg and meat production seems to be established, the necessity of testing the half-bred chickens in both directions is self-evident.

Following this suggestion, the present work was intended to determine the value of the cross-bred chicken in regard to egg production, its growth, maturity, resistance to disease, including size, habits, and weight and fertility of eggs; and, finally, to compare in this connection the half breeds with the natives.

BREEDING WORK

Trials have been made to find out the cheapest, quickest, and most efficient way of improving the Philippine chickens by crossing the hens with the pure-bred roosters representing the egg and general-purpose type, or in other words, by producing half-breed chickens, commonly called "mestizos." This College last year started this work of improvement with the Animal Husbandry I Class and it has been continued during the present year by the writer.

With regard to the first generation of half-breeds, Mr. Cruz states that 18 Brown native hens with two pure-bred Black Orpington roosters were placed in the Poultry House No. 1 of the College; in the Poultry House No. 2; 18 White native hens with two pure-bred Single Comb White Leghorn roosters; and in the House No. 3, 16 Brown native hens with two pure-bred Single Comb Brown Leghorn roosters. There are no further available data, excepting that eggs from these different lots were incubated both by hens and by an incubator; that incubation was done twice at two different seasons for two lots of eggs; that the eggs incubated first were hatched during March, April and May, 1914, exclusively under the hens; and that in the other lot the eggs incubated both by hens and the incubator were started during September, 1914.

Three up-to-date poultry houses with wire-fenced pens were used in mating the breeding stock. The same houses were used later for the rearing of the mestizo chickens. One of these houses was used for the laying of the mestizas 8 months later. They are identical in size and shape, equipment and exposure, and are of the shed-roof type. The roof is made of galvanized iron, and the walls of hard wood, while the floor is concrete. The front and back sides

are provided with wire windows to insure ventilation. The pens are 15 meters long and 12 meters wide; they have been planted with sorghum, which provides the chickens both feed and shade. These houses are provided with perches, dropping boards, and nests on one side, and with drinking pans and bamboo troughs and feeding boxes on the other side. Directly connected with each house is a yard for pasture as well as for run, measuring 57⅓ meters × 68⅓ meters which has been plowed, harrowed, and planted with sorghum and caguios or pigeon peas.

Adjoining the poultry houses and pens described above, there are 8 rearing pens separated from each other by mesh wire. They are 1¾ meters wide, 4 meters long, and 1¾ meters high. The top is covered with wire also, and on this cover coconut leaves were placed to protect the chicks from the excessive heat of the sun. Every pen has one empty cement box used as a brooder for the chickens, which is provided with excelsior or dry cogon leaves. The floor is concrete. On one side of this floor a small ditch runs through all the pens, by means of which fresh water is accessible to the chicks at all times.

SOURCE OF STOCK FOR THE BREEDING WORK

The pure-bred Black Orpington and Single Comb White Leghorn roosters used in this breeding work were purchased from reliable men in Manila who have been breeding poultry for many years. The pure-bred Single Comb Brown Leghorn roosters were purchased from A. J. Henry, of Los Baños; and the native hens divided into two groups (white and brown) were obtained from different owners in the neighboring barrio of San Antonio, Los Baños. The previous breeding history of none of individuals of this foundation stock is available; but all of them were more or less carefully selected as to type, vigor, and size; and with respect to the roosters, as to their breeding characteristics as well.

HOUSING THE CHICKS

Shortly after the arrival of the native chicks and after the record of development of the chicks in all the lots was well started, disease broke out, affecting all the breeds under experiment and killing almost all the Brown Leghorn mestizo and the native chicks. For this reason another experiment had to be started, making it necessary to rearrange this work into two lots. The first lot was to include all the mestizo and native chicks which were hatched during March, April and May, 1914. The second lot was to comprise all the natives and mestizo chicks which were hatched during the time elapsing from September 9 to October 1, 1914.

As soon as the hatching was complete, the hens with their mestizo chicks in the first lot; that is, the Black Orpington, White Leghorn, and the Brown Leghorn, were transferred to the rearing pens already described. They were kept in these pens side by side with the native chicks obtained from the barrio, for about four or five weeks. After that time they were transfered to the Poultry Houses Nos. 1 and 2, where they could have more space in the adjoining pens. When most of them reached about three months of age, they were allowed to run in the big yards adjoining the pens.

The second lot of the Brown Leghorn mestizo and native chicks which were hatched by incubator were brooded in the incubator room for about a month, using the incubator as a brooder. Those chicks which were hatched by hens in the second lot were reared in the same pens occupied formerly by the first lot of chickens. As soon as these were

about five weeks old, they were transfered to the Poultry House No. 2, and a few weeks later they were moved again to house No. 4, which has a longer yard with plenty of shade and green grass at all times.

CARE AND FEED OF THE CHICKS

All the chickens in the first lot (Black Orpington, White Leghorn, and Brown Leghorn and native chicks) were given exactly the same treatment as regard housing and feeding. Only 15 to 25 chicks were allowed to remain with one hen, and the breeds were kept separate.

The chicks were fed four times a day during the first two weeks; later they were fed only three times a day; and when they were allowed in the houses and pens, were fed two times a day only. The first feed consisted of boiled rice from the students' mess, hard boiled eggs, and white ants, or *anay*. These were given alternately during the day. They were also later given finely ground corn and rice bran. The corn was given almost every day during the first year. When corn was lacking, cassava and sweet potatoes were given as substitutes. Of course green grass, fresh water, and grit were given at all stages of their growth.

Since this is not a feeding experiment, judgment only was exercised towards supplying the fowls enough feed.

The poultry houses and rearing pens were cleaned every day during the year, so that their surroundings were made as sanitary as possible. During the ravages of the disease mentioned above, the houses and rearing pens were thoroughly cleaned, and disinfected with creolin and crude oil.

GROWTH

The experiment on growth was started on March 19, 1914, with the first Black Orpington mestizo chicks. These were tagged and weighed, and the record on growth was regularly taken. The rest of the Orpington, the White Leghorn, and Brown Leghorn mestizo which were hatched thereafter, were also tagged, weighed, and their weights recorded. The hatching of the mestizo chicks already mentioned took place at different times during the period from March 19 to May 25, 1914.

From April 18 to May 3, 1914, newly hatched native chicks were purchased from different places in the barrio of San Antonio, Los Baños. And they too were tagged, weighed, and weights recorded at once. These native chicks were to be compared with the mestizo chicks in their development.

The growth record of each individual in each breed used in this work is necessary in order to know their exact development during the growing period when subjected to exactly the same conditions, as well as to compare the performance of each individual and of each breed in this respect, with a view of selecting the best individual for future work in breeding. In regard to this last point, Dr. Pearl, (5) of the Maine Agricultural Experiment Station says that there ought to exist for all standard breeds of fowls normal growth curvatures, from which could be read off standard weights which should be attained by vigorous sound birds not especially fed for fattening at each particular age, from hatching to the adult condition. The material developed in this paper is, however, not enough to warrant the plotting of such curves for the breeds involved in this experiment.

It is to be regretted that our growth records are not complete, largely because the method of tagging used was not very efficient. On this account several individuals in the first lot as well as the second lot could not be identified and were discarded from the experiment. Thus the number of individuals concerned in the experiment was considerably reduced.

In the discussion of the rate of growth J. H. Robinson (6) says that ordinary young chicks weigh about 1½ ounce (or about 43 grams) when 24 hours old. At three to four weeks they should weigh ½ pound (or about 226 grams);

at six to eight weeks 1 pound (or about 453 grams); at nine to eleven weeks 2 pound (or nearly 1 kilo); at three months a chicken of the medium weight breeds should weigh from 2½ to 3 pounds (or a little over 1 kilo); the cockerels generally being the heavier birds; but the average cockerels are often outweighed by the largest pullets.

In the following table of average growth of all breeds in this experiment a similar method of getting the rate of growth is adopted. It must be stated, however, in this present case, that the growth of chickens pertaining to the first lot was recorded separately from that of the chickens belonging to the second lot. In the same way, in averaging the growth separate account was also taken for each lot in order not to confuse the conditions under which the chickens in the first lot throve with those affecting the second lot of fowls. Furthermore, in getting the average growth of each breed in the second lot, the figures of the growth of the individuals which lost their tags are included, for it was deemed that this circumstance would not vitiate the average result. Thus, in this particular case, the average becomes fairly representative of a greater number of individuals.

Table No. 1 shows the weekly growth and increase in weight of the Brown Leghorn mestizo and native chickens belonging to the second lot. As these chickens were raised at the same time and given the same treatment as regards housing and feeding, a fair comparison on growth can be made. The weekly growth and increase of the Black Orpington and White Leghorn mestizos in the first lot is also given in the table, but only a rough comparison can be made, for the reason that they have been raised four months ahead of the chickens in the second lot.

The native chick is evidently lighter than the grade Brown Leghorn chick when about 24 hours old, the former weighing only an average of 25.00 grams; at the end of the first week, the native chick weighed an average of 40.16 grams, and the Brown Leghorn mestizo an average of 45.71 grams; at two weeks, the native weighed 51.66 grams, and the mestizo 68.89 grams; at four weeks the native weighed 104.50 grams, and the mestizo 118.84 grams; at six weeks the native weighed 140.46 grams, and the mestizo 176.01 grams; at eight weeks the native weighed 199.38 grams and the mestizo 225.37 grams. At three months the native chicken weighed an average of 256.52 grams, and the Brown Leghorn mestizo chicken an average of 284.54 grams; at 4 months the native chicken weighed 303.54 grams and the mestizo 350.94 grams; at five months the native weighed an average of 351.3 grams an the mestizo 437.3 grams. The above figures show that the native chickens developed more slowly than the Brown Leghorn mestizo chicken, the rate of weekly increase of the former being 16.5 grams, and that of the latter being 20.5 grams on an average.

When a comparison was made between the native chicken in the second lot and the Black Orpington mestizo in the first lot it was found that in nearly all the stages of development, this mestizo chicken had a higher rate of growth. At five months the Black Orpington mestizo weighed an average of 386.7 grams, while the native weighed only at that time 351.3 grams. The table shows also the weekly growth rate which is 21.66 grams. The development of this mestizo chicken (and it is true also with the other breed of mestizo) is more rapid towards maturity than that of the native.

The Single Comb White Leghorn mestizo, on the other hand, did not develop as well as the native chicken or the Black Orpington mestizo during the first three or four months of age, but at five months a more rapid development was noted; the table shows that at that time it already weighed an average of 383.9 grams. The native was 351.3 grams. Its weekly rate of growth was 17.7 grams on an average.

TABLE 1

AVERAGE WEEKLY GROWTH

Week	0 (Hatching)	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th	13th
Breed	gm.	gm.	gm.	gm.	gm.	gm.	gm.	gm.	gm.	gm.	gm.	gm.	gm.	gm.
First Lot														
Mestizo Black Orpington..	—	61.32	76.76	97.63	117.72	130.16	143.70	166.60	183.83	205.98	234.05	264.19	299.65	311.35
Mestizo White Leghorn...	—	50.72	68.65	80.73	88.48	98.93	119.09	143.92	159.80	187.16	202.93	219.44	242.26	259.42
Second Lot														
Native.....	25.00	40.16	51.66	83.05	104.50	124.67	140.46	173.76	199.38	226.40	241.42	249.64	256.52	270.65
Mestizo Brown Leghorn...	28.06	45.71	68.89	91.49	118.84	150.83	176.01	198.95	225.37	241.53	256.34	271.44	284.54	297.41

AVERAGE WEEKLY GAIN OR INCREASE

First Lot														
Mestizo Black Orpington..	—	—	20.89	20.09	12.44	13.66	22.90	17.23	22.15	28.07	30.14	35.46	11.70	15.65
Mestizo White Leghorn...	—	—	17.93	12.08	7.75	10.45	20.16	24.83	15.88	27.36	15.77	16.51	22.82	17.16
Second Lot														
Native.....		15.16	11.50	31.39	21.45	20.17	25.79	33.30	25.62	15.02	8.22	8.41	19.51	11.37
Mestizo Brown Leghorn...		17.65	33.18	22.16	27.35	31.99	25.18	22.94	26.37	16.21	14.81	15.10	13.10	12.87

Mestizos	*Weekly Rate grams*
Black Orpington.....	21.66
White Leghorn.....	17.72
Brown Leghorn.....	20.50
Native.....	16.50

TABLE 1.—(Continued.)

AVERAGE WEEKLY GROWTH

Week	14th	15th	16th	17th	18th	19th	20th	24th	28th	32th	36th	40th
Breed	gm.	gm.	gm.	gm.	gm.	gm.	gm.					
First Lot												
Mestizo Black Orpington..	—	—	—	—	327.0	356.74	38.67	605.55	853.5	1037.2	1317.1	1377.1
Mestizo White Leghorn...	—	—	—	—	349.52	361.51	38.39	591.8	687.1	822.7	890.9	933.6
Second Lot												
Native.....	280.71	288.91	305.54	306.10	320.02	331.78	351.3	—	—	—	—	—
Mestizo Brown Leghorn...	315.76	335.85	350.94	371.18	388.40	411.43	437.3	—	—	—	—	—

AVERAGE WEEKLY GAIN OR INCREASE

First Lot												
Mestizo Black Orpington..	—	—	—	—	15.65	29.74	29.96	55.15	16.95	45.81	40.51	39.65
Mestizo White Leghorn...	—	—	—	—	23.52	11.99	21.78	32.22	39.36	25.45	32.57	10.80
Second Lot												
Native.....	10.04	8.60	9.10	12.79	11.74	11.02	19.42	—	—	—	—	—
Mestizo Brown Leghorn..	18.35	20.09	15.09	20.24	17.32	22.93	25.87	—	—	—	—	—

Mestizos	*Weekly Rate grams*
Black Orpington.....	21.66
White Leghorn.....	17.72
Brown Leghorn.....	20.50
Native.....	16.50

INCUBATION

Since in the first experiment nearly all of the Brown Leghorn and native chickens died with a disease that will be mentioned later, strong effort was taken to start another trial. A new plan was formulated; it was to use the "Queen" incubator of the College for hatching the eggs of these breeds. Native eggs were then bought from many different sources at the barrio of San Antonio. The Brown Leghorn mestizo eggs were produced in the College, so there was no doubt as to their being new eggs. The incubator was started on August 13, 1914, using 236 native eggs and 20 Brown Leghorn eggs. The directions used in running the incubator were the ones furnished by the Queen Incubator Company. The operation was carefully and patiently performed, taking the necessary records, and the result of this incubation after the first test gave 18% as the number of eggs fertile.

In the second testing it was found that the number of live germs was so reduced that it was decided to start another lot. The few fertile eggs left were then turned to three brooding native hens. When the remaining fertile eggs were hatched, it was found that the majority of the hatches, as recognized by general appearance, were mestizo chicks of the cross between the native hen and the Brown Leghorn roosters.

The incubator was kept running while purchases of native eggs were being made by the writer himself, to make sure that they were as new or fresh as possible. In this second incubation which was started on August 31, 254 eggs were used—68 Brown Leghorn mestizo eggs, and 186 native eggs. The same procedure was used, and this work was carried to the end.

TABLE 2

RESULT OF INCUBATION

Result	*Brown Leghorn Mestizo*	*Native*
Number of eggs put in	68	186
Infertile eggs	18	36
Dead germs	5	17
Number of eggs broken	0	88
Dead in shell	5	25
Pipped	2	3
Fertile eggs in first test	56	98
Vigorous chicks	25	36
Percentage of fertile eggs to total number of eggs	82.53	52.68
Percentage of hatched eggs to total number of eggs	36.76	19.35

The above table is self-explanatory, giving results which are in favor of the mestizo chicken in regard to the fertility and hatchability of the eggs of both breeds concerned.

MORTALITY

Beginning April 18, 1914, several lots of native chicks were introduced from the barrio of San Antonio and they were placed side by side in the pens with the half-bred chicks (Black Orpington, White Leghorn and Brown Leghorn) for purposes of comparison. Before this introduction, the half-bred chickens concerned in this experiment were growing rapidly, but a few deaths occurred due probably to lack of care. During the first two weeks after introducing native chicks no signs of disease were observed; but at the beginning of the third week the condition was noticeably changed. Growth was affected in the case of individuals that were apparently diseased, and it was evident that the chickens were suffering from diarrhoea or cholera, and chicken pox. All the chickens, both natives and mestizos, being side by side, had about the same degree of exposure to the diseases. Although the affected ones were isolated and other measures were taken to bring the diseases under control, their ravages continued. The humidity due to the frequent rains increased the fatality of the diseases,

and every week the continuous deaths were very discouraging. The diseases went on uncontrolled for about 10 weeks, then disappeared. It was evident that the chicks introduced from the barrio brought the infection.

As an outcome of this calamity some of the mestizos and nearly all of the native chickens succumbed, but an opportunity was afforded for comparing the different breeds in regard to their disease-resisting qualities as shown in the table of mortality. It must be stated also that a Brown Leghorn and a White Leghorn chick were lost.

Table No. 3 shows that the mortality of the Black Orpington mestizos was about 54%, that of the White Leghorn mestizo about 32%, and that of the Brown Leghorn mestizo about 90%, while the mortality of the native chickens was the highest, being 96%. The higher mortality of the Brown Leghorn, as compared with the Black Orpington and White Leghorn, was accounted for by the fact that they happened to be the youngest of all the chicks at the time the disease was at its maximum virulence.

TABLE 3

MORTALITY DUE TO DISEASE

First Lot of Mestizo and Native

Date when recorded (1914)	*No. of Black Orpingtons recorded.*	*No. of White Leghorns recorded.*	*No. of Brown Leghorns recorded.*	*No. of Natives recorded.*
March 3	11	1	—	1
March 9	1	9	—	—
March 16	—	12	—	—
March 22	23	21	—	1
March 25	5	1	—	—
March 31	6	2	—	—
April 3	12	12	—	—
April 12	12	4	6	1
April 18	—	—	—	26
April 21	—	—	—	9
April 22	—	—	—	7
May 3	—	—	—	11
May 23	—	—	1	—
May 24	—	—	19	—
May 25	—	—	5	—
Total number of chicks	75	62	31	56
Number of chicks left Aug. 1st	34	42	3	2
Number of chicks left Oct. 31	34	42	3	2
Death	41	20	28	54
Percentage of mortality	54.1	32.2	90.3	96.4
Second Lot of Mestizo and Native				
Sept. 6, 1914	—	—	3	13
Sept. 8, 1914	—	—	—	3
Sept. 9, 1914	—	—	17	—
Sept. 19, 1914	—	—	16	21
Oct. 1, 1914	—	—	19	—
Total No. chicks	—	—	55	37
Left Jan. 17, 1915	—	—	—	22
Left Jan. 27, 1915	—	—	40	—
Total left	—	—	40	22
Death	—	—	15	15
Percentage of Mortality	—	—	27.2	40.5

In connection with mortality it should be mentioned that the lot of small chickens representing only the Brown Leghorn and native chickens, which were started four months later, was also attacked by the disease. The favorable weather, however, coupled with the experience gained by the caretaker in the first lot at the outset of the work, greatly decreased the mortality in the second trial. Only 27% of the Brown Leghorn mestizos died while the death rate among the natives was 40%.

MATURITY OF MESTIZO CHICKENS

According to Graham Hope (7) the age at which the domestic fowl matures varies from less than six months to eight or nine months. He believes that heavy breeds take a longer time to mature than light ones, and that chickens nearing maturity can be forced to lay eggs at an early age by giving them some stimulating food, such as meat, but not believing in forcing egg production, he advises feeding pullets on a very plain diet.

In these experiments the pullets were not forced to early maturity. A simple grain ration was given, and they were allowed to run in the yard to seek green and insect food. It is assumed that chickens have attained maturity when they begin laying, and on this assumption maturity in this work will be discussed.

TABLE 4

MATURITY OF MESTIZO CHICKENS

Breed	No. of Hens	Age in Days when First Egg was Laid		
		Max.	Min.	Av.
Black Orpington.....	17	342	259	300.2
S. C. White Leghorn..	15	326	276	302.7

The Black Orpington mestizo pullets were hatched during the months of March and April, 1914, just before the rainy season. So the chicks were reared during the rainy season, which is thought to be unfavorable for their normal development. The first eggs were laid by two Black Orpington mestizos, at the beginning of the dry season about November, 1914. One hen laid on November 23 at the age of 260 days; and another at the age of 259 days. One hen, on the other hand, laid her first egg on February 15, 1915, at the age of 342 days. She was the last to lay, while the rest in the flock laid at 10 months.

The age at which the single comb White Leghorn mestizos laid eggs, varies from 9 to 10 months. Being a cross of the pure-bred White Leghorn, which belongs to the light breeds of chickens, they should lay earlier than the Orpington mestizos, according to the statement of Graham Hope (7) and other poultry breeders. In both cases, however, maturity was longer deferred than what might be expected under these conditions, although some individuals laid as early as 8½ months of age. For this reason, improvement along this line is evidently possible through selection and probably through change of environment.

The native chickens, which were intended for purposes of comparison and which were hatched and reared at the same time as the two mestizo breeds, were attacked by disease during the early part of their development. Only one male was left alive. However, one native hen was accidentally hatched March 3, 1914, and raised with the first lot of Black Orpington mestizos. She was given the same treatment as the Orpington mestizos. She laid her first egg on October 31, 1914, in other words, she reached maturity at the age of 7 months and 27 days or about one month earlier than the two earliest maturing Orpington mestizos. On account of the failure of the native stock it is impossible to compare it with the two mestizo breeds in regard to maturity, and a representative number of native chickens could not be secured at that time.

Efforts were made to fill in this important part of the work by the later incubation of the eggs already mentioned above, but at this stage of the work the chickens produced therefrom have not reached maturity.

EGG PRODUCTION

The rate of production of eggs by any breed of chicken is always based on the yearly record. Therefore, the ability of any individual hen or any breed concerned in this work should be determined after one year's laying. But this experiment was started on March, 1914, at the time of hatching, and maturity was not attained until about December of the same year, so the data of egg production is not complete. A continuation of the work will show the exact performance of the average individual mestizo, as well as the best breed of mestizo.

During the early part of November a marked indication of desire to lay was shown by most of the pullets. All the mestizo hens which were then on free range, including native hen No. 11 already mentioned above, were accordingly confined in House No. 3, Pen 3, where they were allowed to lay.

A comparison of monthly egg production by mestizo and native hens shows that the Black Orpington mestizos began laying in the latter part of November; that the White Leghorn mestizos began to lay in the latter part of the following month. During the month of November there were only 2 Black Orpington mestizos that laid, giving an average of 3 eggs per hen for the month, and during the month of December, 4 Black Orpington mestizo hens and 2 White Leghorn mestizo hens laid 13 and 5 eggs each, giving respectively an average of 3.2 and 2.5 eggs per hen. During the month of January 15 Black Orpington mestizo hens laid 95 eggs with an average of 6.4 eggs, and in the case of the White Leghorn mestizos 13 hens produced 70 eggs with an average of 5.4 eggs. The record for 22 days during the month of February gives 18 Black Orpington mestizos laying 119 eggs with an average of 6.6 eggs; and 18 White Leghorn mestizos laying 87 eggs with an average of 4.8. During this period all of these mestizo hens were given, as uniformly as possible, the kind and quantity of feed that is listed in the table in question.

Computing the yearly record of the three breeds from figures covering the production of January and February, the Black Orpington gives in round numbers 78 eggs, and the White Leghorn 61.

TABLE 5

Comparison of Monthly Egg Production of Black Orpington Mestizo and S. C. White Leghorn Mestizo

	Nov.	*Dec.*	*Jan.*	*Feb.**
Black Orpington				
No. of hens laying.	2	4	15	18
No. of eggs laid...	6	13	95	119
Average.....	3	3.2	6.4	6.6
S. C. White Leghorn				
No. of hens laying.		2	13	18
No. of eggs laid ..		5	70	87
Average.....		2.5	5.4	4.8

* Only the first 22 days of February are taken into account.

WEIGHT OF MESTIZO EGGS

The weight of eggs of all the mestizo hens was taken from November 22, 1914, to February 23, 1915. Each egg was weighed as soon as laid. The weight of one dozen eggs as given in the table is not the weight of 12 eggs weighed together, but it is the sum of the weights of 12 single eggs. Table No. 6 gives the weight of 12 eggs laid respectively by ten Black Orpington mestizo hens to show the weight of a dozen eggs as laid by each hen. Table 7 gives weights of 12 eggs laid by White Leghorn mestizo hens. In other columns of these two tables under the heading "Mixed Eggs," are the weights of eggs taken from common native hens.

Up to February 23, 1915, 18 Black Orpington mestizo hens produced 19 dozen; and 18 White Leghorn mestizo hens, 12 dozen eggs. The average weight of one dozen eggs for the Black Orpington mestizo is 532.21 grams; that of the White Leghorn mestizo, 513.79 grams; and that of the native, as found by Allarey, is 514.91 grams. It is seen that the weight of a dozen eggs of native chickens is very slightly lower than that of the Black Orpington mestizo, being much less than half the weight of a single egg, and somewhat higher than that of the White Leghorn mestizo.

These differences will be shown in Table 8 compiled from Allarey's table of weight of eggs and the data in Tables 6 and 7.

TABLE 6

COMPARISON OF MESTIZO AND NATIVE EGGS

Breed	*Place*	*No. of Dozens weighed.*	*Average weight of 1 dozen—in ounces.*	*Average Weight of 1 dozen—in grams.*
Allarey's	Lucena	21	17.69	508.59
Native	Manila	13	17.95	516.06
Hens	Calamba	14	17.86	513.38
	Los Baños	50	18.01	517.79
	General Average		17.91	514.91
Mestizos: Black Orpington	College of Agriculture	19	—	532.51
White Leghorn	"	12	—	513.79

GENERAL CHARACTERISTICS OF THE SINGLE COMB WHITE LEGHORN MESTIZO COCKEREL

The general characteristics of the White Leghorn mestizo both male and female, are traceable more to the native hen than to the pure bred White Leghorn cock.

Head large; comb single, erect, and deeply serrated; wattles, long, thin; eyes full and bright; ear lobe medium in size. Neck long, well arched and with sufficient hackle.

Body medium in size; breast round and prominent; back slightly rounded and short; wings, large and well carried; skin, fine and thin. Tail carried high and moderately full.

Thighs and shanks medium in length and strong; feet with well spread, long and straight toes. Carriage upright.

Weight averages about 1.6 kilos.

Color of plumage in general white or yellowish white. Beak, yellow or white; eyes, red; comb and wattles, bright and red; face, bright red with no trace of white; ear lobe, white, light cream, or red; shanks, yellow or white; toe nails, yellow, white, or black.

They have the habit of flying high, being very nervous, and easily frightened. They can stand simple food and are hardy.

PULLET

Head medium, more or less erect; wattles small, rounded and thin; eyes full and bright; ear lobe medium in size; neck of medium length and quite full. Body small, wedge-shaped; shoulders wide; back long and slightly rounded; breast round and full; skin thin and delicate, tail long and fairly rounded; wings well formed and close to the body.

Shanks and thighs medium in length, and strong.

Carriage upright as in the cock. Weight of the average sized pullet, about 1 kilo.

Plumage white all over. Beak yellow or white; eye red; comb and wattles red; face, red; ear lobe, red or light cream. Shanks yellow, white or black. Toe nails, white, yellow, or dark.

The pullets have the habit of flying; but with careful handling this habit is lost, and they become gentle and tame, like the mestizo Black Orpington pullet. They are good foragers, and are more industrious and more active than the Orpingtons. Very few get broody.

GENERAL CHARACTERISTICS OF THE BLACK ORPINGTON MESTIZO COCKEREL

The characteristics of the female parent (the brown native hen) are apparent in the male mestizo.

Head, large; neck, long. Comb, large; evenly serrated and erect. Wattles well rounded and large; hackle, moderately full.

Body deep, but not as full as in male parent; back short, with wings well

formed and carried close to the body; skin white, thin, and fine in texture; flesh, firm; tail, long and carried high and gracefully; thighs, long; shanks, long and strong.

The cockerel is tall and quite graceful, but lacks the compactness of the male parent, the pure bred Black Orpington rooster.

The weight of the mestizo cockerel is about 1.6 kilos. There is no doubt that this average weight will be exceeded later when they are fully grown.

The general color of the mestizo cockerel is brownish black. The black color of the male parent is not as dominant in the male as in the female progeny. The hackle, as well as the saddle feathers, are more or less brown; the brown color of the female parent is evident in these parts only. The rest of the body is black, including the toe nails.

The Black Orpington cockerels are nervous and can fly over inclosures of medium height, but not to the same extent as the White Leghorn mestizo cockerel. They are hardy and can stand ordinary feeding. They are not as tame and gentle as the Black Orpington mestizo pullets.

PULLET

In general it may be said that the external characteristics of the male parent are strongly dominant in the female progeny.

Head of medium size, appearing more or less like the head of the male parent; eye full and bright; comb single, more or less evenly serrated of medium size and erect. Ear lobes medium in size; wattles well rounded and of medium size; neck well proportioned and well curved.

The body is as graceful and erect as the body of either parent, but less compact; it is broad, long, deep, and full; back long; shoulders broad, wings well formed and carried close to the body; skin thin and fine in texture, flesh firm; tail medium in size, and inclined backward and forward.

Thighs medium in size and length; shanks long and medium in size.

The Black Orpington mestizo pullet is larger than the common native hen, the average weight being 1.51 kilos.

The uniform black color of the Black Orpington mestizo pullet is certainly inherited from the male parent. A few specimens have the hackle slightly brown but not to the extent seen in the mestizo male.

The Black Orpington mestizo pullets are tame, gentle, and they stand confinement readily. They do not fly and and are not easily frightened. They are somewhat slow in their movements.

CONCLUSIONS

1. The natural advantages which this country offers would undoubtedly make poultry raising very profitable if carried on with proper care and good management.

2. Native hens crossed with pure bred Single Comb Brown Leghorn roosters laid a greater percentage of fertile eggs than the native hens crossed with native roosters.

3. The mestizo chickens were more resistant to disease than the native chickens.

4. The Black Orpington and Single Comb White Leghorn mestizo chickens were mature at the age of about 9½ months; that is, they laid eggs at about that time.

5. The Black Orpington mestizo hens laid more eggs than either the Single Comb White Leghorn mestizo or the native. Under the same conditions, the White Leghorn mestizo laid more eggs than the native hen.

6. The eggs of the Black Orpington mestizo hen were slightly heavier than those of the native or the Single Comb White Leghorn mestizo hen.

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Black Orpington Mestizo Chickens

Single Comb White Leghorn Mestizo Pullet

A Study of Mushroom Culture in the Philippines

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Thesis presented for graduation from the College of Agriculture, No. 50

The growing of mushrooms is not an industry that anybody can carry to success without first studying the principles which govern the culture. The success of the growers depends on their intelligent study of conditions and on experience. [1] In the second paragraph of the discussion by L. H. Bailey on *Mushrooms* in the *Cyclopedia of American Horticulture*, we read: "There is no science of mushroom culture; that is to say, one does not know why he fails and why he succeeds; by practice and experiment one hits upon or develops a method, and if he persists, he may become skilful, but it is next to impossible for him to impart his knowledge. If he writes an article, he describes his method in detail and deprecates other methods; but the learner will be as likely to succeed by other methods and neither man will know why." Some mushroom growers keep their methods secret, while some, especially the spawn makers, will let their methods of growing be known to the public and only keep secret their methods of manufacturing brick spawn. In selling the brick spawn the dealers usually accompany it with a pamphlet in which their methods are described, showing just how to carry out every step from the preparation of materials and making of beds to picking the crop and sending it to market.

The growing of mushrooms appeals to many as a healthful occupation and as one that does not necessitate the use of any big space nor a great expenditure of money. They can be grown in places which cannot be used otherwise, as for example, in old barns, in cellars, in natural and artificial caves and abandoned coal mines. They can be grown also in tubs and in small boxes. [3] Mushrooms thrive best in an atmospheric temperature of from 50° F. to 60° F. [4] They do not require cultivation except at times when we desire to raise great quantities of them for market. The occupation is clean and very light. The product finds ready sales at high prices in the local markets.

The mushrooms are members of the group of fungi called *Agaricaceae*. They are found in all parts of the world, and occur everywhere after the coming of rain, when the air is moist and steamy. As food the mushroom is nutritious, healthful and palatable. [6] In the first paragraph of the paper of Dr. B. M. Duggar, on *The Cultivation of Mushrooms, Farmers' Bulletin No. 204*, we read: "From the time of Pliny, and perhaps much earlier, these plants have been sought as an article of diet, and have been cultivated for many centuries." Again, according to the *Encyclopedia Britannica:* "There are few more useful, more easily recognized, or more delicious members of the vegetable kingdom than the common mushrooms. They form an important part in the alimentation of many people. The peasants of Russia are never without them, and for future use they hang them up to dry." [7] "In Tierra del Fuego the natives live almost entirely on mushrooms. In Australia many species of *Boletus* are used by the natives and the *Mylitta australis* is commonly called native bread." [3] In the Punjab, India, mushrooms are universally eaten by the natives in a dry or fresh state. [5]

Although the economic importance of mushrooms is recognized everywhere—both by civilized and uncivilized

people—yet their culture has been practiced in comparatively few countries. England and France are the countries where the culture has become highly developed and the latter excels in the quantity produced. France is said to be the home of the mushroom industry. [2] The mushroom which is universally cultivated for commercial purposes is the species known as *Agaricus campestris*. In the cities of Paris and Bordeaux, for commercial purposes the culture is carried on in stone quarries, in chalk pits and in underground chambers, because in these places the conditions of temperature and moisture are easily regulated. [8] The success of the culture in caves has made many people believe that mushroom must be grown in caves or at least in dark places. Mr. A. V. Jackson, on the contrary, says that these places are used for mushroom growing because they are unfit for other purposes, and that they are used, not on account of the absence of light, but because they are the most economical places; i. e., giving large space at a very little expense. [3] In America success has not been so general; but unusual interest in the subject has prevailed within the past few years, and according to the recent reports of some American authorities on mushroom culture, it seems that the industry is now successful in some of the States. In Canada, the United States, Russia, [9] China, Japan, etc., good edible mushrooms grow naturally in fields and pastures. China and Japan produce enormous quantities of wild mushrooms in forests, lawns, fields and pastures, and export them dry and canned to other countries. The Philippines import some of them. The dry mushrooms from China are called "*Hiongko*" by the Chinese. France and England are the greatest markets for cultivated mushrooms, and the greatest preserving factures are located at Montrichard, Vendome, and Moree. [8] The following table, from *Farmers' Bulletin No. 204*, gives us approximately the amount of mushrooms sold through the central market of Paris, 1898 to 1901:

Year	*Total Prod. in lbs.*	*Immediate Consump. lbs.*	*Am't. preserved in lbs.*	*Mean price per lb. Cents.*
1898...	3,960,000	2,200,000	1,760,000	26
1899...	6,820,000	4,092,000	2,728,000	26
1900...	8,580,000	4,180,000	4,400,000	25
1901...	9,680,000	3,740,000	6,160,000	24

In 1906, the French production of mushrooms amounted to 3,540,590 kgms. which were worth 5,948,110 frs. or £238,000. [9] In Paris alone, according to another statement, ₱1,500.00 worth of mushrooms are sold daily. [10] In France, the production is so large that not only is the city of Paris fully supplied, but also large quantities are exported to different parts of the world. [11] The Philippines import some of this produce in cans, commercially known under the name of *Champignons*. The can is 3×4.5 inches in size and contains 12 to 15 pieces of small mushroom "buttons." The price of a can varies from 20 to 40 centavos. The modern preparation of mushroom beds, whether in caves, shade or open places, is practically the same in all countries where the culture has been handled with scientific accuracy. Some growers, in preparing the beds, use stable manure (usually of the horse), soil and straw; others manure and soil alone; and others manure alone for their material. According to the paper of Dr. B. M. Duggar, there are two general types of mushroom beds; namely, the flat beds which are commonly known as the English type, and ridge beds which are commonly known as the French type. The English type is made in such a way that the beds may be arranged in the form of shelves, thus occupying the

entire space. The shelves are arranged one above the other on both sides of the cellar, thus leaving a walk in the middle of the cellar. This type is advantageous where the amount of floor space is limited.

The ridge beds, known as the French type, are made in such a way that the floor space only is utilized. On the floor of the cave the beds are made about 2 ft. wide and not more than 18 to 20 inches high when compressed and cased. For convenience, the beds are generally placed side by side, leaving a walk between. The difference between the two types is that the flat bed requires less ground area for a greater area of beds.

The manure is piled in the form desired, and then pressed into the bed in order to prevent drying and burning when the secondary fermentation takes place. Spawning must be done when proper moisture is obtained in the manure and the temperature is not more than 80° F. If spawn bricks are used, they are broken into pieces two inches square. These pieces are then planted in prepared beds, from one to two inches below the surface, and about one foot apart, and the bed is then pressed into final shape. The beds made may then be cased with fine loam after some days. The surface of the bed should be kept constantly moist, and the temperature should be 53° and 60° F. [1]

MUSHROOM GROWING IN THE PHILIPPINES

Mushrooms are universally eaten by the natives of the Philippines. The vernacular names for mushrooms vary in several localities of the Archipelago. In Leyte they are called *ulapin,* in Negros and Iloilo, *ojong;* in Camarines, *tobo;* in Zambales, *dakdakan;* in Tagalog, *cabuti;* in Pampanga, *payong-payungan;* in Pangasinan and Ilocano, *oong;* in Cagayan and Isabela, *carulu;* and in the Negrito dialect, *kuat.* They are found daily in local markets during the wet season or in the months of June, July, August, September and October, and disappear gradually as the dry season begins. The cost of mushrooms varies in different localities; i. e., in towns where there are few people, the price of one pound is from 40 to 50 centavos; in large towns, from 40 to 60 centavos.

The culture of mushrooms in the Philippines has not yet been made a subject for thorough investigation. An attempt to cultivate them has been made in Pampanga Province. The method of growing mushrooms is based upon two principles which are more or less founded upon superstitions or at least are without any scientific foundation. The two principles for convenience can be stated as follows: (1) That the mushroom is the flower of thunderbolts and lightning. (2) That the mushroom should appear spontaneously in plots, without previous spawning. The fact that the plant happens to appear on ant hills and on several places just a day or two after a heavy rain accompanied by thunder and lightning has led the natives to believe that the inoculation of the fungus is mainly dependent on those factors, and so is universally called, "The flower of thunderbolts and lightning." In different localities of the Philippines, especially in Pampanga, it can be noted that people who are interested in gathering mushrooms from fields, pastures and forests for market will tell with emphasis that mushrooms *can be obtained today* because it rained and thundered yesterday. There is no producer in the Philippines that uses spawn to start the culture; and the common people know nothing about mushroom spores and mycelium. They claim that to produce it no seed

is needed in the plot, but only the necessary food, and then inoculation will occur when thunder and lightning begin.

This superstitious method, however, although it always works in a way, yet does not produce as much as the methods of Europe. This method is objectionable from the fact that in the prepared plot it is not always edible mushrooms that appear, as has been actually found in the course of the present experiments at the College of Agriculture. Many growers, however, still claim that a food of fixed composition will produce a certain mushroom only; i. e., if rice straw is used then rice-straw mushrooms will result, if bagasse, bagasse mushrooms are expected; and furthermore, it is a popular and erroneous belief with some ignorant natives that mushrooms growing in poisonous material are poisonous. Each variety of mushroom gets its native name from the material it grows in.

There are four methods of growing mushrooms in Pampanga: namely, the rice-wash method, common salt method, bagasse method and banana method. The first two methods consist in piling chopped rice straw in a favorable place, usually under bamboo trees. The rice-straw must be ten inches thick above the surface of the ground after being tramped by the feet. Those two are the same in all respects except that the solutions used for keeping them moist are different; for example, in the rice-wash method, the solution used is the washings from the rice before cooking. This liquid looks milky and contains water and starch. For the common salt method, the liquid is a weak brine, a solution containing one spoonful of salt to every eight liters of water. The bagasse method consists in piling together fine pieces of sugar-cane bagasse and heavily watering with sugar cane juice scum at least daily for one month, afterwards keeping the bed moist with water. The banana method consists of piling chopped banana trunks, stumps and leaves to a thickness of about one foot and a half, or sometimes more. It is said by the natives that the thicker it is the better. As in the other cases, it should be watered to keep it moist.

In all parts of these methods, it is important to note that no previous spawning is to be done in the bed. The growers have only to attend to the preparation of the bed, its care and the gathering of the mushrooms.

The mushroom that is commonly expected in all of the different beds is *Volvaria esculenta* (described in 1912), the commercial variety in Pampanga. This mushroom appears in the beds during the wet season in great quantity, and disappears at the beginning of the dry season if the beds are not kept properly moistened daily. It is claimed by the native growers that the producing period can be carried through the dry season if proper care is given to the beds. However, there are few, if any, who succeed in growing them during the dry season. It is unlike the European method in that the surface of the beds during the producing period is not uniformly covered with mushrooms; i. e., one part of the bed is producing mushrooms while other parts are not. This is primarily due to the lack of uniform inoculation at the beginning. The mushrooms are usually collected when they have reached the full stage of development. In Europe, mushrooms are usually gathered while in the "button" stage.

For an estimate of the extent of the industry in Pampanga, the writer has employed the help of his brother, Julito Vicencio, and his mother, Benita A. Santos, to weigh and record daily the mushrooms that enter the local markets of Arayat. The result of their work

for the months of May, June, July and August, gives a daily average of 3 lbs. or 90 lbs. per month for this town.

EXPERIMENTS AT THE COLLEGE

Five mushroom corrals were constructed near the river bank under bamboo shade on the College farm. The corrals were each three meters by seven meters and of rectangular form. Bamboo fences were constructed around each corral to keep out chickens and other animals. Each corral consisted of two parallel beds, leaving a walk between. A door was provided at one end of each corral. The beds were each one meter wide and six meters long and one foot deep. The sides of the beds were braced with split bamboo, and fortified with bamboo stakes to prevent the soil at the edges from weathering. One of these corrals was provided with a plane roof made largely of bamboo trellis and leaves of palm trees. To prepare each corral requires an average of five days for one laborer. The cost of each corral was calculated to be ₱8.00. The corrals were numbered from one to five.

Corral No. I.

The two beds of this corral were filled with chopped rice straw about ten inches thick. For convenience, the beds were labeled A and B. Bed A was moistened daily with rice wash, and Bed B was moistened daily with water, while once a week it was watered with weak brine.

Corral No. II.

The two beds of this corral were filled with chopped rice straw and labelled in the same way as the beds of corral No. I. Bed A was watered daily with fresh water containing a small quantity of molasses, and Bed B moistened with water, and once a week sown with 300 grams of *ipa*, or rice hulls.

Corral No. III.

Bed A was filled with fine pieces of bagasse about eight inches thick. This bed was divided into two, and the parts numbered 1 and 2. On No. 1, thick scum of sugar-cane juice, was poured once a week for one month; No. 2 received nothing except water to keep it moist. Bed B was half filled with sugar cane scum and the residue found at the bottom of a syrup tank.

Corral No. IV.

Bed A was divided into three parts, numbered 1, 2, and 3. No. 1 was filled with decayed bamboo leaves, No. 2, with decayed bamboo stems and No. 3, with old decaying bamboo stumps. Bed B was divided in two parts, numbered 1 and 2. No. 1, was filled with old bamboo roots and No. 2, with chopped banana stems and stumps. All of these plots were kept constantly moist.

Corral No. V.

This corral was provided with shade, and the two beds were labeled A and B. Bed A was divided into three parts, numbered 1, 2, and 3. No. 1 was filled with chopped rice-straw and daily kept moist with rice wash; No. 2, was filled with chopped rice straw and once a week watered with a weak solution of brine; and No. 3 was filled with chopped banana stems and trunks and kept moist with a little water. Bed B was divided into four parts and numbered 1, 2, 3, and 4. No. 1 was filled with chopped rice straw, and once a week watered with a small quantity of molasses in solution; No. 2 was filled with pieces of cane bagasse and kept moist with water; No. 3 was filled with pieces of cane bagasse, and thick scum of cane juice was poured on its surface once a week for one month; No. 4 was half filled with sugar-cane scum and residue found at the bottom of the syrup tank.

In all of the different beds, mycelium of different species of mushrooms was inserted to find out which species is best adapted to the special substratum. The fungi expected to yield most readily to cultural methods were introduced into the different plots, and all those which appeared there spontaneously were carefully studied.

MUSHROOMS SPONTANEOUSLY APPEARING IN THE CORRAL PLOTS

Many species grew spontaneously in the mushroom plots at the College. Few of them are edible, while the majority of them have no economic value and cannot be used for food. Although the non-edible species which occurred in numbers have no importance to the prospective mushroom grower, yet they were taken into account in this study in order to definitely distinguish the edible species by their natural characters.

The following table shows the spontaneous production from the different substrata, the amount in ounces, time of appearance, and economic value:

Date of appearance	*Corral No.*	*Quantity produced in oz.*	*Economic value*
April 12—July 25	I-B, II-B	2 oz.	Non-edible
April 10—Aug. 13	I-A, I-B, II-B	7 "	"
May 2—Sept. 4	III-A, B-I, V-B2, B3, B4	31 "	"
April 8-14—Feb. 3-15	I-A-B:II-A-B; V-AI-2-3	19 "	"
May 8—May 28	I-A; II-A-B; IV-B2	9.3 "	Edible
April 3-14—Feb. 10-15	I-A-B; II-A-B; IV-B2: V-AI-2-3-V-BI	54 "	Non-edible
June 3—July 11-14	V-B2	1.2 "	"
Dec. 2-14—Jan. 7-15	V-B2-4	.8 "	"
Nov. 28—Dec. 4-14	I-A-II-B	2.5 "	"
Nov. 12-14—Jan. 5-15	Edges of II-A-B	18.6 "	"
Jan. 4—Jan. 29-15	Edges of I-A	4.5 "	Edible.
Dec. 12-14—Feb. 2-15	IV-A2-BI	17.4 "	Non-edible
May 6—Sept. 10-14	I-B, II-B	9.7 "	"

CONCLUSIONS FROM THE PRECEDING TABLE

1. The inedible species are numerous as compared with the edible ones.

2. The fact that no edible species has grown spontaneously from the beds of the roofed corral, No. V, suggests that completely shaded and hidden places are not suitable for growing mushrooms from spontaneous inoculation.

3. The fact that others beside the edible *Volvaria esculenta* had appeared in the plots shows that the native belief of the Pampanga growers "that a food of fixed composition will produce a certain mushroom only" is not necessarily true.

4. From the very small quantity of the edible mushroom obtained from the plots, it seems that the practice of growing the mushroom in the way it is done in Pampanga cannot be followed with good results in Los Baños.

GROWING OF MUSHROOMS BY SPAWN AT THE COLLEGE

During the months of April, May and June an attempt was made to secure spawn or mycelium of several edible mushrooms. The effort to get them was rarely crowned with success. The spawn was very largely that of *Volvaria esculenta*. This species was found growing near the sugar mill of Mr. A. Salva Cruz. June 17, 1914, the writer personally went to Arayat, Pampanga, to get mycelium or natural spawn of *Volvaria esculenta*. The spawn obtained was in the form of irregular solid blocks composed of decayed rice straw and pasted together with carabao

dung. This spawn was rich in mycelium and small "buttons." The pieces were brought to Los Baños in wooden boxes. In digging out this spawn great care was taken that none of the mycelium should be injured. The method that the writer used was to dig out the whole substratum, two or three inches thick, occupied by the fungi. All the material secured was broken into pieces, about two inches square. The pieces were equally divided and distributed among the plots, inserted into the surface. Each piece was accompanied with a label, on which its number was marked. Again, two kinds of spawn of *Agaricus campestris* were received by the College of Agriculture from the Germain Seed and Plant Co., Los Angeles, California. One of the spawn bricks was marked "English" and the other, "French." The former received College No. 3390, and the latter No. 3391. The difference between the two was quite evident. The English spawn brick was hard, solid, dark in color and well compacted, and the French spawn brick was coarse, brown and largely made up of straw.

The result of each inoculation in each bed, both as to germination and yield, has been recorded and tabulated for the college records. For publication it is sufficient to note that only one of all the plots, namely, V-A 3, failed to show any germination by the native spawn, and but few plots showed germination of less than half of the pieces of spawn. Neither culture of *Agaricus campestris* grew at all. Beside the planted *Volvaria*, several other fungi grew in one or more plots. A *Lenzites* inoculated into plot IV-A germinated and produced mushrooms. *Lepiota chlorospora* was tested by inoculation, but without results.

CONCLUSIONS FROM THE INOCULATION EXPERIMENTS

1. The majority of the pieces of the natural spawn of *Volvaria esculenta* that contain "buttons" produced mushrooms.

2. It is observed that nearly all the "buttons," from 3 to 12 mm. in size, in the fresh pieces inserted, became mature.

3. Many of the pieces of the natural spawn of *Volvaria esculenta* that contained only mycelium also showed germination. Thus this mushroom can be grown from ordinary spawn.

4. Out of the 102 pieces of the spawn of *Volvaria esculenta* that were inserted into the different plots, 53 pieces gave mushrooms. This is 51.9 per cent germination.

5. Comparing the percentage of germination of the spawn of *Volvaria esculenta* obtained from Arayat, Pampanga, and that from Los Baños, the latter is more effective than the former by 14.5%.

EXPERIMENTAL WORK AT ARAYAT

For comparison, similar experiments were carried out at Arayat, Pampanga. The experiments ran from March 3, 1914, to December 21, 1914, inclusive. The work was attended to by Mr. Julito Vicencio, but under full direction of the writer. Instead of building many separate corrals as had been done with the experiments at the College of Agriculture, only one corral was constructed. It was twice as long and as wide as any one of those made at the College. It was built in an open place, directly exposed to the sunlight during the whole day. The edges of the beds were braced with limestone bricks instead of bamboo stems. The beds were filled with rice straw whose depth when wetted and pressed flat against the floor was about two feet. The cost of constructing this single corral amounted to ₱7.40. The beds were labeled "A" and "B."

Bed A was divided into three equal plots, were numbered 1, 2, and 3.

Plot No. I.—This plot was kept always moist with rice washings.

Plot No. 2.—This plot was sown with 200 grams of *ipa* or pieces of rice hulls. The surface was kept moist with water.

Plot No. 3.—This plot received no water at all except from the rain.

Bed B was likewise divided into three parts, and each partition received its corresponding label, No. 1, 2, and 3.

Plot No. 1.—This plot was daily watered with a very weak solution of salt.

Plot No. 2.—This plot was kept moistened with water and syrup.

Plot No. 3.—This plot was kept moist with a solution of four gallons of water, and half a liter of molasses and one ounce of common salt, every second day.

SPONTANEOUS INOCULATION OF THE PLOTS AT ARAYAT

About the end of the month of May, i. e., about three months after the construction of the beds, the rice straw laid on the surface was observed to turn dark brown. The first monthly report of Mr. J. Vicencio, to the writer, read as follows:

"Arayat Pampanga, P. I.,
June 12, 1914.

I want to let you know that the beds you ordered to be prepared have been bearing mushrooms daily since May 7th. There are only two kinds of mushrooms growing from the plots. One of them is common edible mushroom that is commonly called by us *"cabuting dayami."* This mushroom has a sack at the base of the stem. This kind appears in large quantity. The other kind is not edible and appears in small amounts. In order that you can see them I will preserve specimens in alcohol. The edible mushrooms are collected every morning. We carefully record their weight before cooking them."

Examination of the specimens preserved in alcohol shows that the edible kind is *Volvaria esculenta*, and the other one, a *Coprinus*.

The following table shows the amount of *Volvaria esculenta* produced by this spontaneous inoculation, from each plot, each month for six months:

Months	BED A			BED B			Total
	Plot I	Plot II	Plot III	Plot I	Plot II	Plot III	
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
May	4.2	3.1	.1	1.2	3.00	.02	11.8
June	2.8	4.0	.5	2.3	1.8	1.5	12.9
July	4.1	2.5	.2	2.7	1.5	1.1	12.1
August	1.5	.5		1.0	.1	.2	3.3
September	.4	.2		.09		.04	.73
October	.09						.09
TOTAL	13.09	10.3	.8	7.29	6.4	3.04	40.92

NOTE:—Mr. Vicencio prepared descriptions and plates of all the mushrooms, 14 in number, which appeared in his plots. Beside the *Volvaria*, these included *Psalliota*, *Corrinarius*, *Derminus*, *Coprinus*, (2 species), *Hypholoma*, *Lepiota*, *Hyphorrhodius*, *Pholiota* and *Lenzites*. As none except *Volvaria* have any known economic value, his descriptions are interesting only as a matter of sytematic botany, which is not the subject of his thesis. His description of *Volvaria*, is, therefore, the only one included.

VOLVARIA ESCULENTA

Pileus fleshy, nearly plane or slightly raised into an umbo, becoming broadly convex when old, slightly fragile, buckthorn brown, bearing fine, hair-like scales, flesh white, turning brown when dried; lamellae thin, free, white, becoming brown after six hours exposure to light; stipe tapering or slightly narrowed towards the top, white, becoming pale brown when old, solid and fleshy; volva mummy brown. No part of the volva remains on the top of the pileus in the

form of scales; annulus absent; spore-print pale brown; spores ovate, almost white, size 10×5 microns.

Pileus 5-12 cm. broad; stipe 5-13 cm. long; 0.5-1.5 cm. thick; average weight of each mushroom 25 gm.

Taste palatable; strongly odorous or like the odor of rice straw.

Economic value: the commercial edible mushroom in Pampanga.

From the results of the experiments made in Arayat, as part of the work on this thesis, two computations have been made. One upon the average yield, and the other on the yield by the most productive plot. To a considerable extent, the computations are based upon estimates; but, as far as possible, these estimates are based on experience in this kind of work in the mushroom district of Pampanga.

COMPUTATION I

BASED ON THE AVERAGE YIELDING PLOTS

Expenditure in the First Year.

Cost of construction of corrals to cover an area of 1 Ha.	₱2,373.00
Cost of maintaining 5 laborers for 4 months at ₱20.00 per month	400.00
Cost of planting	5.00
Cost of hauling the product to market	10.00
Total interest in the 1st year at 6%	150.68
Total investment in the 1st year plus interest	₱2,938.68
Collection in 1st year	1,800.00
Loss in 1st year	₱1,138.68
Interest on loss, during second year, at 6%	68.32
TOTAL	₱1,207.00

Expenditure in the Second Year.

Cost of repairing the corrals	₱ 300.00
Cost of maintaining 5 laborers for 4 months at ₱20.00 per month	400.00
Cost of planting	5.00
Cost of hauling the product to market	10.00
Total interest at 6%	14.30
Total expenditure in the 2nd year plus interest	₱ 729.30
The loss in 1st year plus interest	1,207.00
Total amount to be returned in the 2nd year	₱1,936.30
Collection in the 2nd year	1,800.00
NET LOSS AT END OF THE 2ND YEAR	₱ 136.30

COMPUTATION II

BASED ON THE BEST YIELDING PLOT

Expenditure in the First Year.

Cost of construction of corrals to cover an area of 1 Ha.	₱2,373.00
Cost of maintaining 5 laborers for 4 months at ₱20.00 per month	400.00
Cost of planting	5.00
Cost of hauling the product to market	10.00
Total interest in 1st year at 6%	150.68
Total expenditure in 1st year plus interest	₱2,938.68
Collection in 1st year	2,900.00
Loss in 1st year	₱ 38.67
Interest on loss, during 2nd year, at 6%	2.32
TOTAL LOSS PLUS INTEREST	₱ 41.00

Expenditure in the Second Year.

Cost of repairing the corrals	₱ 300.00
Cost of maintaining 5 laborers for 4 months at ₱20.00 per month	400.00
Cost of planting	5.00
Cost of hauling the product to market	10.00
Total interest in 2nd year at 6%	14.30
Total expenditure in 2nd year plus interest	₱ 739.30
Loss in the 1st year plus interest at 6%	41.00
Total amount to be returned in the 2nd year	₱ 720.30
Collection in the 2nd year	2,900.00
TOTAL GAIN DURING 2 YEARS	₱2,129.70

From the above computations it will be observed that if we base our calculation on the average figure for yield per hectare, obtained from different plots, as shown in computation 1, the loss will be ₱136.30 at the end of the second year; but if, as shown in computation II, the best yielding plot be taken as the basis, ₱2,129.70 will be gained in the same length of time and for the same labor. It is an open question as to whether this business would be safe and renumerative on a large scale. The Pampanga people consider their returns good, when operating on a small scale, and with the very little attention which they give to the culture. Improvements in methods of building corrals and handling cultures should increase the income.

SUMMARY

1. *Volvaria esculenta* can be cultivated at least as easily as *Agaricus campestris.*

2. The Pampangan method of spontaneous growing of mushrooms (*Volvaria esculenta*) can not be practiced successfully everywhere.

3. The Pampangan beds are not necessarily suitable for the inoculation of other edible fungi.

4. The rice washing, weak solution of brine and molasses in solution, all help to produce favorable conditions for *Volvaria esculenta.*

5. Growing of mushrooms by spontaneous inoculation will pay, provided that in the locality where it is done the cost of labor and material is low.

6. The growing of mushrooms (at least, *Volvaria esculenta*) will make a temporarily successful business for the months of May, June, July, and August.

7. *Volvaria esculenta* grows in the open sunshine as well as in the shade.

8. The thicker the rice straw deposit in the bed, the better it is for spontaneous inoculation by *Volvaria esculenta.*

The writer is greatly indebted to Professor Charles F. Baker, for his suggestions during the progress of the work, and to his brother Julito Vicencio for help in carrying out the work at Arayat, Pampanga.

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Effect of Girdling on Parang and Forest Trees

By Aniceto Villamil

Thesis presented for Graduation from the College of Agriculture (with the Degree of Bachelor of Science in Forestry) No. 54.

By girdling or ringing a tree is meant the removal of the outer layers in such a way as to completely destroy the cambium layer in a continuous line all the way around the tree, leaving the portion of the cambium above this line completely disconnected from the part below it.

Trees are frequently killed by being girdled. This is done whenever it is desired to kill trees before felling. It is a common practice in some sections.

It has been commonly believed and frequently stated that any dicotyledonous tree would be killed by girdling.

The finding of occasional living trees that had been girdled a long time, and that were apparently thrifty or recovering, caused doubt to be thrown upon the general statement that girdling would always kill trees.

In one of the Indian Forest Service publications ("A Concise Manual of Silviculture," 2nd. edition, Calcutta, 1910, p. 25) is found the statement,—"With some soft-wooded trees, with no distinct heart-wood, girdling will not kill the tree."

On March 10, 1913, experiments were started with 13 species of parang trees to determine whether or not there were any of them capable of recovery after girdling. There was such a marked beginning of recovery, in several cases, as to make it seem probable that complete recovery might occur, and it was considered desirable to undertake a more extensive study of both parang and forest trees. Accordingly, on June 17, 1913, a further series of tests was started on 12 species of parang and 9 species of forest trees.

The work was undertaken with the object of finding out: first which species showed signs of recovery; second the method of recovery and the reasons for it; and third, whether parang or forest trees are the more likely to recover.

The trees selected were all in the neighborhood of the College of Agriculture or on the lower slopes of Mt. Maquiling. In all cases, the method of girdling was as follows: A convenient place on the trunk was selected, at a height of 80-150 cm. above the ground. A bolo was used to make an even cut through the bark, entirely around the tree. A second cut, similar to the first, was made 5-11 cm. higher on the tree. The bark between these two cuts was removed and the exposed wood was severely scraped, to make certain that none of the cambium remained on the exposed surface.

The first series of experiments was begun on March 10, 1913, on certain parang trees. All the trees selected were fully exposed to the drying effect of the northeast monsoon and the beginning of the experiment was during a very hot time in the dry season.

The second series was started June 17, 1913, or near the beginning of the rainy season. Both parang and forest trees were included in this series.

The following table gives a list of the trees used in this work:

Parang	Diameter Cm.	Remarks
2 Pusopuso—Litsea glutinosa (Lour.) C. B. Rob.	4.2, 7	No heartwood; hard-wooded tree.
2 Anilao—Columbia serratifolia (Cav.) Pers.	6, 11	No heartwood; soft-wooded tree. One of these is in connection with other uninjured trunks.
2 Anabion—Trema Amboinensis Blume	12, 18	No heartwood; soft-wooded tree.
2 Malapapaya—Polyscias nodosa (D C.) Seem.	11, 14	No heartwood; soft-wooded tree.
2 Guava—Psidium guajava L.	5.5, 6	No heartwood; fairly hard-wooded tree.
2 Leea manillensis.	4, 7.2	No heartwood; soft-wooded tree.
2 Aroma—Acacia farnesiana (L.) Willd.	3.5, 5	Heartwood present; fairly hard-wooded tree; other uninjured trunks connected.
1 Anubing—Artocarpus cumingiana Trée.	3.5	No heartwood; fairly hard-wooded tree.
1 Anonang—Cordia Myxa L.	10.5	No heartwood; soft-wooded tree.
1 Ipil-Ipil—Leucaena glauca (L.) Benth.	4	No heartwood; fairly hard-wooded tree.
1 Marang—Litsea perrottetii (Blume) F. Vill.	9.5	No heartwood; soft-wooded tree.
1 Premna cumingiana Schauer	6.2	No heartwood; soft-wooded tree.
1 Alibangbang — Bauhinia malabarica Roxb.	6.2	No heartwood; fairly hard-wooded tree.
1 Alagao—Premna odorata Blanco	4.5	No heartwood; fairly hard-wooded tree, connected with other uninjured trunks.
1 Isis—Ficus ulmifolia Lam.	5	No heartwood: soft-wooded tree; connected with other uninjured trunks.
1 Hawili—Ficus hauili Blanco	8	No heartwood; soft-wooded tree.
1 Binuñga — Macaranga tanarius (L.) Muell.-Arg.	17	No heartwood; soft-wooded tree.
1 Labayo—Melochia umbellata (Houtt.) Merr.	12	No heartwood; soft-wooded tree.
1 Dita—Alstonia scholaris R. Br.	12.5	No heartwood; soft-wooded tree.
Forest		
Pili—Canarium luzonicum (Miq.) A. Gray.	36	No heartwood; soft-wooded tree.
Lanutan — Polyalthia suberosa (Roxb.) Benth. & Hook. f.	4	No heartwood; soft-woodeded tree.
Bagtican—Parashorea plicata Brandis	13	No heartwood; fairly hard-wooded tree.
Lamog—Planchonia spectabilis Merr.	11.5	No heartwood; hard-wooded tree.
Cupang—Parkia timoriana (DC.) Merr.	5.5	No heartwood; soft-wooded tree.
Catmon—Dillenia philippinensis Rolfe	19.5	No heartwood; fairly hardwooded tree located by river bed.
Malaikmo—Celtis philippinensis Blanco	10	No heartwood; fairly hard-wooded tree.
Balobo—Diplodiscus paniculatus Turcz.	26	No heartwood; fairly hard-wooded tree.
Tamayuan — Strombosia philippinensis (Baill.) Rolfe	5.5	No heartwood; hard-wooded tree.

At the beginning of the experiment, each tree was examined and its condition recorded each week. Later it was found that monthly inspections were sufficient.

The following are the detailed records for each tree:
(Figs. 1 and 2.)

Pusopuso (Litsea Glutinosa (Lour.) C. B. Rob.) No. 1

This is a small hard-wooded and fine-grained parang tree. It was girdled on March 10, 1913, at a very dry time in the hot season. The tree stood in an exposed situation. There was no sign of wilting at any stage in the experiment. Healing of both cut surfaces of the bark was rapid. The growth from the upper surface was much the more rapid and was accompanied by a pronounced increase in diameter for a short distance above the cut surface. The growth from the lower surface was slower and less uniform and was not accompanied by any increase in diameter in its early stages. About six weeks after girdling, and again, four months after girdling, young shoots started from the trunk about 15 to 20 cm.

below the wound. These shoots were cut off.

The new growths from both sides of the wound had met in four months from girdling and had apparently fused a fortnight later.

Two years after girdling (March 10, 1915), the healing is apparently complete and the diameter is now greater below than above the wound, (Fig. 2). This tree made a quicker and more complete recovery than any other.

Pusopuso—Second Tree

This tree was in a similar location to the last, but a little less exposed to the wind. It was girdled June 17, 1913. The process of recovery was as in the first tree, but was a good deal slower. On February 17, 1915, the wound was 13-14 closed and the tree apparently doing well.

Anilao (Columbia Serratifolia (Cav.) Pers.) No. 1

This tree was branched from the ground level. Only one of the trunks was girdled. The girdling was done on March 10, 1913. Some of the leaves wilted and turned yellow during the first month. After this there was no sign of lack of health in the leaves till September.

Healing took place from the upper cut surface with some degree of rapidity. The lower surface healed more slowly and unevenly. The trunk was inclined at a rather sharp angle and the part of the lower cut, on the side toward the ground, seemed to heal much more rapidly than the part of the cut on the other side of the stem. At two months after girdling, shoots appeared on the trunk about 15 cm. below the cut. These were removed. In September the leaves began to turn yellow and the trunk was dead, by the last of November, 8½ months after girdling.

Anilao—Second Tree

This tree was girdled June 17, 1913. For the first three weeks there was a flow of sap from the upper cut surface. With this exception, the behavior was the same throughout as in the first tree. The tree was dead in January, 1914, a little less than seven months from girdling.

Anabion (Trema Amboinensis Blume). First Tree

This tree flowed sap copiously from the upper cut surface. Shoots developed about two months after girdling. There was active, but irregularly, healing from the upper cut surface and the trunk increased noticeably in diameter above the girdle. The bleeding from the upper cut surface continued. The sap fermented and the tree died a little more than four months after the beginning of the experiment.

The second tree of Anabion behaved in the same manner and was dead in about 3½ months from the beginning of the experiment.

Malapapaya (Polyscias Nodosa (DC.) Seem.) First Tree

This tree made very little recovery. The wounds did become covered with a callus and there was slight growth. Shoots appeared within two months after girdling. The leaves showed no sign of damage for nearly two months, when they turned yellow and dropped, being replaced by smaller leaves, which dropped after about two months. The tree was dead five months after the beginning of the experiment.

The second tree of Malapapaya behaved in the same way as the first, except that it sent out no new shoots. It was dead seven months after the beginning of the experiment.

Guava (Psidium Guajava L.) First Tree

This tree showed no signs of wilting or loss of leaves, as a result of girdling. It sent out new shoots about two months after girdling and made a good beginning toward healing its wound. It was destroyed by a storm, about five months after the brginning of the experiment.

Guava—Second Tree

This tree showed no abnormal condition of its leaves during the experiment. New shoots were removed at four weeks, 7 weeks, 10 weeks, 16 weeks, 20 weeks, 31 weeks, 55 weeks, 67 weeks, and 74 weeks after the beginning of the experiment.

On February 17, 1915, the tree seemed to be growing well. There was a marked increase in diameter above the wound, which was about 5-7 healed.

Leea Manillensis Walp. First Plant

This was a large shurb, with several trunks, only one of which was girdled.

One week after girdling, some of the leaves had yellowed, but there was no further sign of an unhealthy condition.

Two months after girdling, the new shoots below the zone of injury were removed.

There was active healing from both surfaces, but much more rapid from the upper, with a marked increase in diameter above the wound.

The trunk was destroyed by a storm five months after the beginning of the experiment.

Second Plant. Fig. 3

This plant sent out new shoots repeatedly. These were removed at 1 month, 4 months, 5 months, 7 months and 10 months from the beginning of the experiment. A yellowing of some of the leaves accompanied the formation of new shoots, in each case. Four months and a half after girdling, large fleshy-roots were sent out from the upper healing surface and from higher up the trunk (see Fig. 3). These were allowed to remain and the tree dried out. It was dead one year after the beginning of the experiment.

Aroma (Acacia Farnesiana Willd.) First Plant

Only one of several branches of this plant was girdled.

The new shoots were cut at 2 months, 5 months, and 8 months after the beginning of the experiment. There was no sign of damage to the leaves at any time. Healing was slow and almost altogether from the upper surface.

The plant was broken by the wind 15 months after the beginning of the experiment.

Second Plant

This plant has shown no sign of damage to the leaves at any stage. New shoots were removed at 2 months, 5 months, 7 months, 8 months, 9 months after girdling. On February 17, 1915, nearly two years after the beginning of the experiment, the plant was apparently perfectly healthy. The lower cut showed no signs of healing. The upper cut surface healed over and the new tissue had grown downward about 8 mm.

Anubing (Artocarpus Cumingiana Trèc.)

There was no development of sprouts till about 18 months after the beginning of the experiment. Both sides of the wound began evidently to heal within one month.

Twenty months after the beginning, the wound was 1-6 healed, but the plant had died.

It was a very small tree and, apparently, could not prevent drying out.

Anonang (Cordia Myxa L.)

New shoots were removed at 7 weeks, 10 weeks, 16 weeks, 19 weeks, 22 weeks, 34 weeks, 37 weeks, and 39 weeks from the beginning of the experiment.

There was marked healing from the upper surface, but none from the lower. The plant was dead 14 months after the beginning of the experiment.

Ipil-Ipil (Leucaena Glauca (L.) Benth.)

The plant made no apparent recovery and appeared to be dying, when it was cut down, two months after the beginning of the experiment.

Marang (Litsea Perrottetii (Blume) F.-Vill.)

New shoots were removed 7 weeks, 10 weeks, 16 weeks, 19 weeks, and 33 weeks after the beginning of the experiment.

During the first few weeks there was some bleeding from the upper cut surface and the leaves, many of them, turned yellow. Recovery was steady. In two months, the bleeding was stopped and recovery became more rapid. On February 17, 1915, 20 months from the beginning of the experiment, 9-10 of the cut surface was covered with new tissue and the plant was apparently very thrifty.

Premna cumingiana Schauer

This plant apparently was making a very good recovery and the new tissue was nearly meeting across the wound, when the plant died, a little over one year after the beginning of the experiment. No reason for the death was apparent.

Dita (Alstonia Scholaris R. Br.).

This tree began to heal slowly from the upper surface, within a month, but the growth was very slow. The plant seemed to be in good condition when it was destroyed by a storm, 13 months after the beginning of the experiment.

Labayo (Melochia Umbellata (Houtt.) Merr.)

This plant made no sign of recovery and was dead within 6 weeks of the time it was girdled.

Alibangbang (Bauhinia Malabarica Roxb.)

This showed very pronounced healing from the upper surface with a marked increase in diameter. The lower cut surface did not heal and the plant was dead 14 months after the beginning of the experiment.

Alagao (Premna Odorata Blanco)

There was active healing from the upper surface and much slower from the lower. Twenty-one months after the beginning of the experiment, the plant was doing well and looked as though it might make a complete recovery; but someone cut it down.

Isis (Ficus Ulmifolia Lam.)

Twenty-three months after the beginning of the experiment the plant was still alive. There had been a slight amount of healing from the upper cut surface, but this had been followed by some decay of bark and a termite attack. The lower surface did not heal over. There was a gradual reduction in the size and number of the leaves. The tree will, apparently, not recover.

Hauili (Ficus Hauili Blanco)

No healing was apparent on the upper surface until nearly nine months had passed. There was then a small amount of healing, but none from the lower surface. After 23 months, only a small amount of healing had occurred from the upper surface, and the lower surface showed no sign of healing. The plant, will apparently, not recover.

This plant and Isis behaved in very much the same way. They repeatedly sent out shorts from below the zone of injury. It is probable that they have stayed alive so long, in spite of failure to recover, because of their milky sap.

Binunga (Macaranga Tanarius (L.) Muell.—Arg.)

This plant made some growth from the upper cut surface, but the lower surface dried out. The plant was dead 11 months after the beginning of the experiment.

Pili (Canarium Luzonicum (Miq.) A. Gray)

This plant very quickly had the upper surface of the wound covered with resin. During the first year there was no apparent healing. After 20 months, about 1-24 of the area of the wound was covered with new growth. There was no apparent healing from the lower surface. The tree had a noticeably lessened number of leaves. No new shoots were developed.

Lanutan (Polyalthia Suberosa (Roxb.) Benth. & Hook. f.)

New shoots were developed five months after the beginning of the experiment. No healing was observed for nearly a year; but the tree remained in full leaf and was, apparently, healthy. After 20 months, about 1-6 of the wound was covered with new growth from the upper surface. The lower surface had done some healing, but had not made any perceptible advance. Some of the leaves were turning yellow at this time.

Bagtican (Parashorea Plicata Brandis)

There was a considerable amount of bleeding from the upper surface, for the first six weeks. There was a slight amount of healing, accompanied by a resin flow, from the upper surface.

The lower surface showed no signs of healing and the tree was dead 10 months after the beginning of the experiment.

Lamog (Planchonia Spectabilis Merr.)

A slight healing of the upper surface was noticed, after three weeks. The leaves did not appear to be abnormal during the first 10 months, but were shed in the 11th month. New leaves appeared two months later. Fifteen months after the beginning of the experiment, some small roots were sent out above the girdle. After 20 months, the wound was about 1-16 healed from above. The lower surface had done only a small amount of healing and the callus was not complete. The leaves were reduced in number.

Cupang (Parkia Timoriana (DC.) Merr.) Fig. 4

Growth was very rapid from the upper cut surface and was accompanied by a greater increase in diameter than was observed in any other species. The lower surface healed slowly. A few small roots developed above the girdle, after 6 months.

February 16, 1915, 20 months after girdling, about 1-3 of the surface of the wound was covered by the growth from the upper cut surface. There had been a very small amount of growth from the lower cut. The diameter just above the girdle was more than three times as great as that below. For about three meters above the girdle the trunk was greater in diameter than it was below the girdle. (See Fig. No. 4.)

Catmon (Dillenia Philippinensis Rolfe)

This tree seemed to remain vigorous at all stages of the experiment. There was a rather copious flow of watery

sap from the upper cut surface. This kept the wound moist throughout the whole time.

Within one month, active healing was taking place from above and below. At 20 months, recovery seemed to be nearly complete. New growth started on the girdled surface in a number of spots, at the ends of pith-rays. There was also pronounced development of new tissue from both cut surfaces, but the larger amount from the upper. All of the patches of new tissue extended and were fusing. The increase in diameter was not so marked in this as in some other trees, but a large number of short, stout roots were sent out. More than 100 of these were found at one time, from just above the wound up to 4 m. above.

Malaikmo (Celtis Philippinensis Blanco).

There was copious bleeding from the upper surface of the wound for the first two months. There was no sign of healing. The tree was apparently thrifty for ten months, but was dead one year after the beginning of the experiment.

Balobo (Diplodiscus Paniculatus Turcz).

There was a considerable amount of bleeding, from the upper cut, during the first month.

After 2½ months, the upper surface began to heal. After 5 months, a few small roots started above the girdle. After 20 months, 2-11 of the wound surface was covered by the growth downward from the upper cut; the lower cut surface had formed a callus and made slight growth. The number of leaves was markedly reduced.

Tamayuan (Strombosia Philippinensis (Baill.) Rolfe).

There was no apparent healing and no apparent damage to the plant in the first 10 months. At 20 months the wound was ½ covered by the growth from the upper surface and there was a marked increase in diameter above the wound. The growth from the lower surface was slight. The tree was apparently in good condition and promised to make a complete recovery.

The following tables show the diameters of the trees at the time the experiment commenced and the circumference above and below the girdle at various times.

GIRDLED TREES AND SHRUBS

Parang — March 10, 1913

Name	Width of cut in cm.	Diam. in cm. below girth	July 3, 1914 Circum. below girth	July 3, 1914 Circum. above girth	Remarks
1 Leea manillensis	5½	4			
2 Anabion—Trema amboinensis Blume	7½	18			
3 Pusopuso—Litsea glutinosa (Lour.) C. B. Rob	5½	7	25.7	33.00	Measured close to wound on both sides.
4 Labayo—Melochia umbebelleta (Houtt.) Merr	6	12			
5 Binuñga — Macaranga tanarius (L.) Muell.-Arg	7½	17			
6 Aroma—Acacia farnesiana (L.) Willd	5	5	17.2	19.9	Same.
7 Anilao—Columbia serratifolia (Cav.) Pers	7	11			
8 Hawili—Ficus Hauili Blanco	7	8	27.2	29.7	Same.
9 Isis—Ficus ulmifolia Lam	5	5	16.7		
10 Aroma—Acacia farnesiana (L.) Willd	5	3.5			
11 Alagao—Premna odorata Blanco	7	4.5	19.3	32.6	25 cm. above the wound.
12 Alibangbang — Bauhinia malabarica Roxb	7	6.5			
13 Guava—Psidium guajava L	5	6			
14 Malapapaya—Polyscias nodosa (DC.) Seem	7	11			

GIRDLED TREES AND SHRUBS—Continued

PARANG — JUNE 17, 1913.

Name	Width of cut cm.	Diameter cm.	July 15, 1913: Circumference in cm. above the wound	July 15, 1913: Circumference in cm. below the wound	July 2-3 '15.: Circumference in cm. below the wound	July 2-3 '15.: Circumference in cm. above the wound	Remarks
1 Pusopuso — Litsea glutinosa (Lour.) C. B. Rob	7	4½	15½	14 3/10	14.7	18.4	
2 Marang — Litsea perrottetii (Blume.) F.-Vill	9	9½	31½	30	30.8	38.3	
3 Premna cumingina Schauer	6	6½	24 2/5	23	21.1	24.6	
4 Guava—Psidium guajava L	7	5½	18 7/10	19	19.00	23.4	
5 Anubing—Artocarpus cumingiana Tréc	5½	3½	12 1/5	11 2/5	11.5	19.00	
6 Dita—Alstonia scholaris R. Br	7	12½	40 1/5	41 4/5	41.7	Close to wound 41.7	45.5 cm., to 20 cm. from edge of wound.
7 Ipil-Ipil—Leucaena glauca (L.) Benth	7	4	13	13 1/5			
8 Anabion—Trema amboinensis Blume	10	12	47	46 1/10			
9 Malapapaya—Polyscias nodosa (DC.) Seem	8	14	47½	47 9/10			
10 Leea manillensis	7½	7½	26 4/5	26	25.2	35.3	
11 Anonang—Cordia Myxa L	8	10½	37 3/10	37½	37.5	43.7	
12 Anilao—Columbia serratifolia (Cav.) Pers	5	6	21 2/5	20 4/4			

FOREST — JUNE 17, 1913

13 Bagtican—Parashorea plicata Brandis	9	13	48½	47 7/10	47.7	51.3	
14 Catmon — Dillenia philippinensis Rolfe	9	19½	65½	66 1/5	66.3	70.4	
15 Balobo — Diplodiscus paniculatus Turz	10½	26	84 3/5	87 1/10	87.2	87.9	
16 Malaikmo — Celtis philippinensis Blanco	7	10	33½	33 7/10	33.7	34.5	
17 Lamog — Planchonia spectabilis Merr	7	11½	39 3/5	39 1/5	41.5	43.9	
18 Cupang — Parkia timoriana (DC.) Merr	5	5½	21	17 1/5	17.9	Close to wound 36.2	21.9, 20 cm. from edge of wound.
19 Pili — Canarium luzonicum (Miq.) A. Gray	11	36	115½	119½	121.2	119.2	
20 Lanutan — Polyalthia suberosa (Roxb.) Benth. & Hook. f.	5½	4	11	12 2/5	12.5	11.7	
21 Tamayuan — Strombosia philippinensis (Baill.) Rolfe	5	5½	19½	19 1/10	19.2	23.1	

The most common external signs of injury noticed were the wilting or yellowing of leaves and the dropping of some of them. The number of leaves was then reduced for those plants not naturally deciduous. The new leaves were not as large as the former ones.

Some of the girdled trees exuded water from the upper cut surface in great quantity; others, in small amount or not at all. If the wilting of the leaves and exuding of water are combined in one species the tendency is to hurry up the death of the plant, as happened in the 2 Anilao and 2 Anabion.

Almost all the girdled plants developed shoots below the wounds, especially those growing in the open, because they received more exposure to the sunlight. The shoots, sprouting below the wounds, were cut as soon as they began to appear so as not to give any chance of manufacturing food materials for those portions below the wounds.

Some interesting features in these observations are the development of new roots from above the wounds and the swelling of the same portions. All species show swelling. Some grow quite large while others become just a little larger.

A few girdled trees showed a temporary recovery; that is, they sent out new shoots and stopped wilting or turning the leaves yellow, which caused doubt as to their future condition. This happened in the 2 Anabion, 2 Leea manillensis, 2 Malapapya, 2 Anilao, Marang and Anubing. These temporary recoveries occurred in the rainy season. It is believed that this temporary relief was due mainly to the frequency of showers.

A complete recovery of plants is certain when the healing barks meet. In some plants the most active growth of bark took place on the upper part of the cut, while the lower cut grew upward to a few millimeters, or the upper cut traveled about 10 times faster than the lower one. A typical example for this is Marang. Pusopuso, Guava, Premna cumingiana and Tamayuan closely resembled this in their way of healing. Their upper cuts were and are pushing downward with a speed approximately double that from their lower cuts. Other plants showed a very slow way of healing. For these the representatives are Bolobo, Anonang, Isis, Pili, Binunga, Aroma and Lamog. The examples for non-healing species are Bagtican, Malapapaya, Ipil-Ipil and Hawili. The method of healing of Catmon was different from all the rest. Both the upper and the lower cuts recovered rapidly, and at the same time fresh areas of new tissue were developed on the wood between the two meeting barks. As these areas of bark became larger, they connected either with adjacent areas or with the upper and lower edges of the wounds. This caused a rapid recovery.

When a partial connection of bark between the upper and lower cuts had occurred, the leaves began to stop turning yellow, increase in number and grow larger in size. A few examples reached complete or nearly complete recovery: These are:—*Parang*: 2 Pusopuso, Guava and Marang; *Forest:* Catmon and Tamayuan.

It is easy to understand the healing of the wounds downward, as there is enough food material in the portions above the girdles. The question to be explained is why in some plants the healing of the lower cuts upwards, with varied rapidity, took place, and why in others it did not do so. One possible explanation is that a portion of manufacutured food material from the upper parts deviates to pass through the wood from the upper cambium layer to the lower one. In this manner the wound

is kept healing upward. For those plants in which the healing action of the lower part of the wounds did not take place or was very little, a possible explanation is that the water with food material was checked by the girdling. In support of this, are the cases of the dead Malapapaya, Binunga, Anilao and Malaikmo, whose stems at the lower portion of the girdle, especially the outer part, were drier or dead, while the upper part were wet or even alive.

The dot formation of fresh bark in Catmon was possibly due to the deviation of food material from the cambium layer above the wound through the uncovered wood. The sap possibly passed through the pith rays downwardly and horizontally. The downward flow helped to rebuild the lower cut while the horizontal flow kept forming the areas of fresh bark.

The healing of Catmon and Tamayuan is not checked during the dry season. But the healing power of some of the other living examples is stopped during this time. The edges of the advancing barks are decaying and some of them are eaten by white ants. These advancing barks, however, during the wet season were continually pushing on.

Complete recovery from girdling so far has occurred only in Pusopuso. Its wound was wholly healed.

Partial recovery has occurred in the second Pusopuso, Catmon, Marang and Guava. Their disconnected barks are partially joined. There has been no injury apparent in Aroma since the beginning, but the disconnected bark seems not to meet.

The table below shows the number of dead trees, the elapsed time and the season when girdled:

Species *Parang*	*Quick death within* ... *months*	*Date of girdling*	*Remarks*
Labayo—Melochia umbellata (Houtt.) Merr.	2	March 10, '13	Dry season.
Anabion—Trema amboinensis Blume.	4	June 17, '13	Wet season.
Anabion—Trema amboinensis Blume.	5	March 10, '13	Dry season.
Malapapaya—Polyscias nodosa (DC.) Seem.	5	March 10, '13	Dry season.
Malapapaya—Polyscias nodosa (DC.) Seem.	7	June 17, '13	Wet season.
Anilao—Columbia serratifolia (Cav.) Pers.	7	June 17, '13	Wet season.
Anilao—Columbia serratifolia (Cav.) Pers.	9	March 10, '13	Dry season.
Binuñga—Macaranga tanarius (L.) Muell.-Arg.	10	March 10, '13	Dry season.
Premna cumingiana Schauer	11	June 17, '13	Wet season.
Leea manillensis Walp.	12	June 17, '13	Wet season.
Anonang—Cordia Myxa L.	14	June 17, '13	Wet season.
Alibangbang—Bauhinia farnesiana (L.) Willd.	15	March 10, '13	Dry season.
Forest:			
Bagtican—Parashorea plicata Brandis.	10	June 17, '13	Wet season.
Malaikmo—Celtis philippinensis Blanco	11	June 17, '13	Wet season.

It is hard to arrive at a definite conclusion as to whether parang or forest trees are the more likely to survive. Many of the soft-wooded trees with no distinct heartwood, whether parang or forest trees, were killed readily. The belief, also, which is frequently stated, that any dicotyledonous tree would be killed by girdling, is found not true.

In some fairly hard to hard-wooded trees there is found to be no very distinct evidence of injury (Aroma). Others heal their wounds steadily, as Catmon, Guava, and Tamayuan. Catmon, Aroma and Tamayuan have distinct heartwood.

The experiment does not show conclusively any weakening of the root system as a result of the girdling.

The evidence is not conclusive as to the effect of the time of the year on the result of girdling. The Pusopuso which made the most complete recovery was girdled in the dry season.

It is probable that girdling will have a more serious effect on old than young trees, though the experiment does not throw much light on this. It was conducted, for the most part, with small trees. One of the most promising bits of recovery was in Catmon, one of the largest trees treated.

Campus News

At the last University Commencement, April 4, 1916, degrees were conferred on graduates of the College of Agriculture as follows:

Bachelor of Agriculture on Florentino F. Cruz, José de Leon, Vicente M. Dawis, Lucio San Miguel, Alfonzo B. Cagurangan, Cornelio Balangue, Marcelino Constantino, Pantaleon U. Bacomo, Gaudencio Palafox.

Bachelor of Science in Agriculture on Domingo B. Paguirigan.

Master of Science on Inocencio Elayda, B. S. A. (Iowa State College) and Nemesio Mendiola, B. S. A. 1914.

Encouraged by the success of its little exposition of last January, the College of Agriculture proposes this year to hold a much more comprehensive one, and has fixed December 1 and 2 as the time.

As an outcome of the work of the tobacco commission of the Bureau of Internal revenue, of which Professor Baker was a member, and which was accompanied by two of the last graduating class, the Government has made funds available for the establishment of a permanent tobacco experiment station in the upper Cagayan Valley. The organization remains somewhat inchoate, administration being vested formally in the Bureau of Agriculture, with the Bureau of Internal Revenue and the College of Agriculture contributing more or less advice and assistance. The plans provide that D. B. Paguirigan and Alfonzo B. Cagurangan are to be members of the staff.

FIG. 1

Girdled Pusopuso (Litsea glutinosa), May 10, 1915, two months after girdling.

FIG. 2

Same tree, two years after girdling. Recovery is now complete and the diameter of the trunk is again larger below than above the girdle.

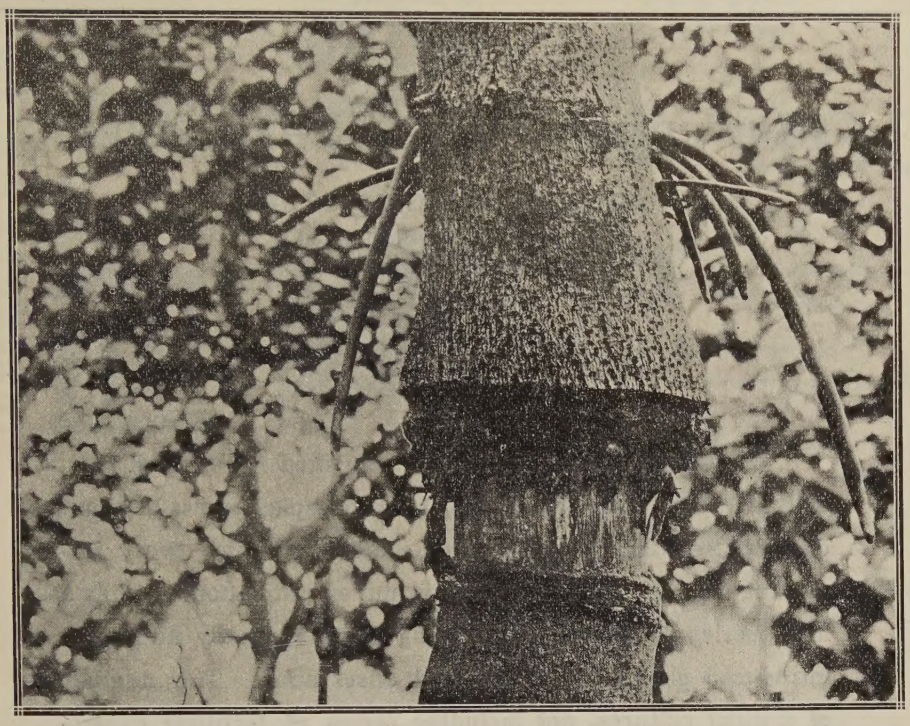

FIG. 3
Girdled Leea manillensis, six months after girdling.

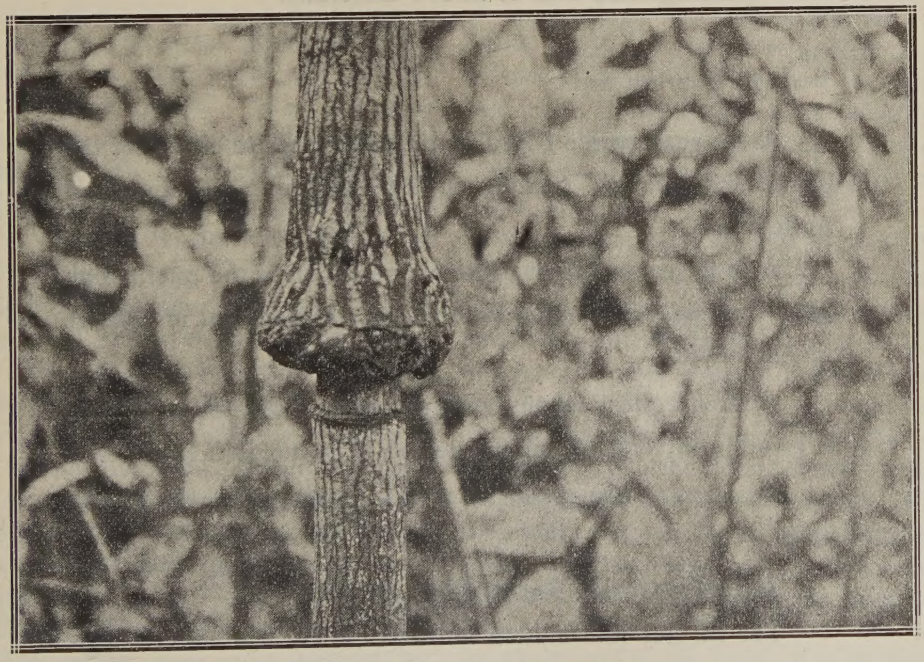

FIG. 4
Cupang (Parkia Timoriana) 21 months after girdling. The swelling continued for more than three meters above the point of injury.

UNIVERSITY OF THE PHILIPPINES

COLLEGE OF AGRICULTURE

LOS BAÑOS

The College of Agriculture has finished its seventh year, with a student body of nearly 450. It occupies a tract of about one hundred and twenty-seven hectares on which every important crop in the Philippines is under cultivation. It has a large series of varieties of leading crops and very numerous introduced plants under test and observation. The number of distinct cultures, not including series of fertilizer experiments, is more than two thousand. The college has six concrete buildings and one of mixed materials.

The courses are:

A six-year course based on the Intermediate course of the public schools, and leading to the degree of Bachelor of Agriculture.

A four-year course based on completion of the public high school course, and leading to the degree of Bachelor of Science in Agriculture.

Graduate work leading to the degree of Master of Science is given to persons holding the degree of Bachelor of Science.

Tuition for non-residents of the Philippines is ₱150.00 a year.

The college year began June 12, 1916.

For further information address the Dean of the College.